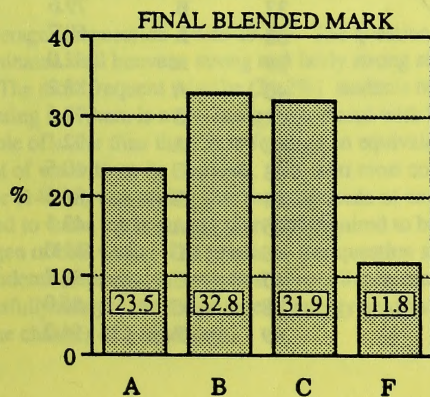
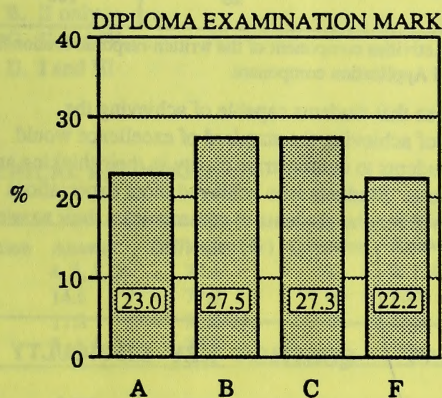
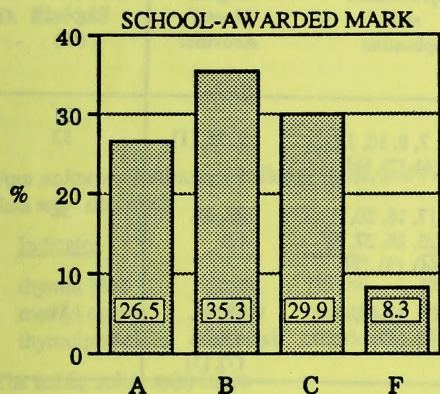




Student Evaluation

Chemistry 30 Diploma Examination Results



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1991 administration of the Chemistry 30 Diploma Examination. The information is most helpful when used in conjunction with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results will be available in the fall of 1991.

DESCRIPTION OF THE EXAMINATION

The Chemistry 30 Diploma Examination consists of three parts: a multiple-choice section of 49 questions worth 70%, a numerical-response section of seven questions worth 10%, and a written-response section of three questions worth 20% of the total examination mark.

ACHIEVEMENT OF STANDARDS

The information reported is based on the final blended marks achieved by 8 610 students who wrote the June 1991 examination.

- 88.2% of these students achieved the acceptable standard (a final blended mark of 50% or higher).
- 23.5% of these students achieved the standard of excellence (a final blended mark of 80% or higher).

Overall, student achievement in Chemistry 30 was acceptable, particularly in their knowledge of core concepts. However, students continued to have difficulty with laboratory-related skills and processes, and in organizing and communicating their chemistry knowledge.

PROVINCIAL AVERAGES

- The average school-awarded mark was 68.7%.
- The average diploma examination mark was 64.1%.
- The average final blended mark, representing an equal weighting of the diploma examination and

RESULTS and EXAMINERS' COMMENTS

SUBTEST

When analysing any detailed examination results, please bear in mind that subtest results cannot be directly compared.

Results are in average raw scores.

Machine scored: 37.81 out of 56

Written response: 7.03 out of 14

•Course Content

-Chemical Energetics: 13.76 out of 22

-Acids and Bases: 15.83 out of 24

-Oxidation-Reduction: 15.25 out of 24

•Process Skills: 26.22 out of 42

-Multiple-choice questions

5, 6, 7, 8, 9, 15, 16, 17, 19, 23, 24, 25, 27, 28, 29, 30, 35, 36, 38, 39, 41, 44, 46, and 47; numerical-response questions 2, 5, 6, and 7; and written-response questions 1, 2, and 3.

•Cognitive Levels

-Knowledge: 14.08 out of 19

-Comprehension and

Application: 22.94 out of 35

-Higher Mental Activities: 7.82 out of 16

EXAMINATION BLUEPRINT

Each question on the examination is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in June 1991 according to these classifications. Numbers with square brackets [] indicate written-response questions, those with round brackets () indicate numerical-response questions, and those without brackets indicate multiple-choice questions.

Reporting Category	Questions by Cognitive Level			Examination Emphasis (%)
	Knowledge	Comprehension and Application	Higher Mental Activities	
Chemical Energetics	1, 3, 5, 6, 12	2, 4, 7, 8, 10, 13, 14, (1), (2), [1]	9, 11, [1]	32
Acids and Bases	15, 19, 21, 22, 24, 30	16, 17, 18, 20, 23, 25, 26, 27, 28, (4), (5), [2]	29, 31, (3)	34
Oxidation-Reduction	32, 34, 36, 39, 40, 42, 48, 49	33, 35, 37, 44, 45, 47, (6), [3]	38, 41, 43, 46, (7), [3]	34
Examination Emphasis (%)	27	53	20	100

Note: For reporting purposes, the Higher Mental Activities component of the written-response section has been combined with the Comprehension and Application component.

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard would obtain a mark of 50% or higher and students capable of achieving the standard of excellence would obtain a mark of 80% or higher. Future examinations will continue to require students to demonstrate clarity in their thinking and understanding of concepts by applying their knowledge to new and novel situations. Students who achieved these expectations were successful on this examination. The next series of diploma examinations will require students to communicate their answers in a clear and concise fashion as well.

MULTIPLE CHOICE

QUESTION	KEY	DIFFICULTY*	QUESTION	KEY	DIFFICULTY*	QUESTION	KEY	DIFFICULTY*
1	B	79.1	18	B	79.9	35	C	77.0
2	B	56.4	19	B	48.9	36	D	79.7
3	A	89.1	20	D	82.4	37	B	79.6
4	D	64.7	21	D	75.7	38	B	60.7
5	C	85.7	22	A	90.5	39	A	62.0
6	A	71.5	23	C	46.9	40	A	88.2
7	C	78.1	24	A	80.0	41	C	72.6
8	D	80.8	25	B	78.3	42	A	92.1
9	B	58.5	26	C	54.3	43	C	40.5
10	D	70.7	27	B	57.9	44	B	86.6
11	D	47.0	28	C	77.2	45	A	43.5
12	B	81.2	29	A	42.6	46	D	41.0
13	C	69.6	30	C	60.5	47	C	93.7
14	A	44.2	31	D	60.2	48	C	56.0
15	B	69.9	32	B	68.4	49	B	54.2
16	C	87.9	33	A	83.1			
17	D	89.0	34	D	75.1			

*Difficulty - percentage of students answering the question correctly

MULTIPLE CHOICE (continued)

The following questions were selected for discussion because they exemplify what is required to meet the acceptable standard and the standard of excellence.

14. The amount of heat required to change 54.1 g of water at 25.0°C to steam at 130.0°C is
- *A. 143 kJ
 - B. 140 kJ
 - C. 23.8 kJ
 - D. 11.4 kJ

16. Four unknown solutions labelled I, II, III, and IV were tested and these data were obtained:

Indicator	I	II	III	IV
thymol blue	green	yellow	green	orange
methyl orange	yellow	orange	yellow	red
thymolphthalein	colorless	colorless	slight blue	colorless

The acidic solution(s) is/are

- A. I only
- B. II only
- *C. II and IV
- D. I and III

Question 14: Although 85.8% of the students recognized that a change in kinetic energy was involved, over half these students did not recognize that there is also a change in state when liquid water is transformed into steam and therefore did not consider the energy required to convert water into steam. Consequently, fewer than half the students (44.2%) correctly answered the question. This result suggests that those students who did not achieve the acceptable standard had difficulty recognizing the changes in energy associated with heating or cooling a substance beyond the point where it undergoes a change in state.

Question 16: Most students (87.9%) correctly analysed indicator colors and determined which solutions were acidic. Those students who answered incorrectly did not appear to make a common mistake, which suggests that students achieving the acceptable standard have a good knowledge of indicator color and the pH range of acids.

NUMERICAL RESPONSE

Question	Answer	Difficulty (%)	Question	Answer	Difficulty (%)
1	4, 3, 1, 2	29.4	5	2, 1, 4, 3	46.9
2	14.6	77.0	6	1.25	73.7
3	11.8	31.8	7	13.2	34.3
4	3, 4, 1, 2	75.0			

Most students correctly followed the instructions for filling in the answer sheet. Students who wrongly recorded correct answers were not penalized; however, students who did not round their answers as instructed lost marks.

The average for question 1 was 29.4%. The question discriminated well between strong and fairly strong students. The most frequent mistake (34.2%) students made was stating that there is more energy associated with boiling one mole of water than there is in forming an equivalent amount of water from its elements. The next most common mistake (14.6%) was stating that the magnitude of energy required to warm ice is greater than that required to burn hydrogen or boil water. The results of this question suggest that students achieving the standard of excellence can successfully analyse the magnitude of energy associated with the changes of a substance.

Use the following information to answer question 1.

- 1. $\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(l)$ at 0°C
- 2. $\text{H}_2\text{O}(s)$ at -60°C $\rightarrow$ $\text{H}_2\text{O}(s)$ at 0°C
- 3. $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(g)$ at 100°C
- 4. $\text{H}_2(g) + \frac{1}{2} \text{O}_2(g) \rightarrow \text{H}_2\text{O}(g)$ at 25°C

1. When the magnitude of energy changes for one mole is ranked from highest to lowest, the order is _____, _____, _____, _____.

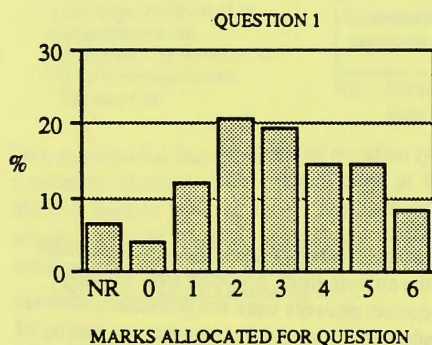
NUMERICAL RESPONSE (continued)

The average for question 6 was 73.7%. The question discriminated between fair and weak students. The most common mistake (8.1%) students made was to add the two reduction potentials rather than to find the difference between the two. The next most common error (5.6%) resulted when students doubled the silver reduction potential. The last identified error (1.3%) was a combination of the previous two. These results suggest that students achieving the acceptable standard are capable of tasks such as determining the net voltage of an operating cell by using the data booklet to select appropriate half-reactions and then using this information to calculate the voltage of a cell.

6. The voltage produced by an electrochemical cell made of Fe(s) and Fe^{2+} (aq) reacting with Ag(s) and Ag^+ (aq) is _____ V. (Give your answer to three digits.)

WRITTEN RESPONSE

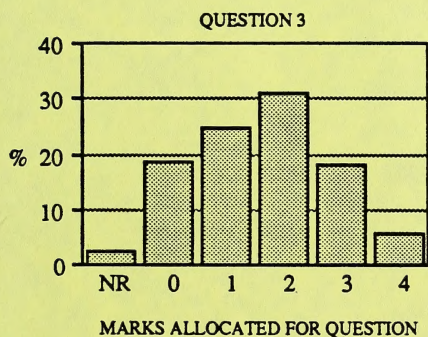
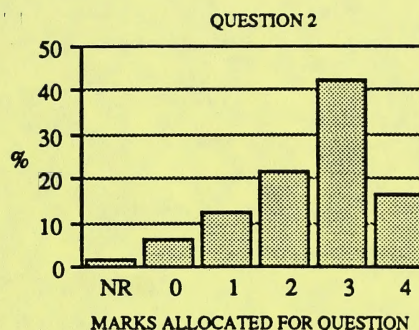
The level of achievement on the written-response section was lower than expected; a little over half the students (57.5%) achieved a mark of 7 or higher out of 14. This was due to the difficulty students had with question 1. Students' performance on questions 2 and 3 was as expected or higher.



Question 1: Slightly more than one-third of the students were unable to solve the question and, as a result, obtained a mark of 2 or less. This was due in part to the dual purpose of the question. It was designed both to measure students' ability to write a laboratory procedure and to test their understanding of combustion calorimetry. A student who did well on only one of these two components generally received three marks, but the student who completed both could attain the standard of excellence. Students who did not meet the acceptable standard were unable to address either component of the question. These students often missed the role of the candle completely and tried to measure its heat of fusion or heat of formation. Those who did recognize that a heat of combustion was required often omitted important steps in the procedure, such as selecting an end point to the experiment, taking the highest temperature reached by the water, or determining the mass of candle remaining. Many of these students arranged the steps in impossible order and used apparatus that was not listed in the question. Students who attained the acceptable standard but not the standard of excellence often had a good understanding of the concept but lacked organizational skills, or vice versa. They gave concise and lucid instructions about how to find the molar heat of fusion of paraffin, or they gave muddled or incomplete instructions about how to find the molar heat of combustion. Students who attained the standard of excellence completed both components of the question. The errors that prevented these students from earning full marks for this question were failure to record results and defining the final temperature taken as the highest temperature attained. These students presented all the required steps in a logical order and clearly expressed themselves so that no interpretation was required by the examiner. On this 6-mark question, the average mark was 2.93 or 49% of the available mark.

WRITTEN RESPONSE (continued)

Question 2 was answered better than expected. This question was selected to distinguish between students below the acceptable standard and those at the acceptable standard. As expected, students who did not attain the acceptable level on the examination scored 0 or 1 on this question. These students had difficulty reading the burettes or they used only one burette reading for the volume of $\text{NaOH}_{(\text{aq})}$. Often these students interchanged the volumes of the solutions; for example, they used the volume of acid for the base. They also had difficulty recognizing that an air bubble would result in a spurious value. Students who attained the acceptable level on the examination were expected to score 2 or higher on this question; most attained a mark of either 2 or 3. They correctly read the values from the burettes, determined the concentration of the $\text{NaOH}_{(\text{aq})}$, and recognized that the presence of air in the tip of the burette would result in a different calculated value. However, they did not explain how the air would affect the concentration of $\text{NaOH}_{(\text{aq})}$ and, as a result, made contradictory statements. Students who attained the standard of excellence on the examination were expected to score 4, which they did. They communicated their understanding of the volume-concentration relationship. On this 4-mark question, the average mark was 2.48 or 62% of the available mark.



Question 3 was answered as expected. This question was selected to distinguish between students at the acceptable standard and those at the standard of excellence. Students below the acceptable level were not expected to do well. These students were able to identify the purpose of the porous cup; however, they did not understand the role of the electrolyte in conductivity. As well, students not achieving the acceptable standard were able to calculate a voltage for the cell, but they did not select the correct oxidation and reduction half-reactions and therefore calculated a wrong voltage. Students who attained the acceptable standard should have scored at least a 1 or a 2. They were able to determine the correct voltage of the cell and to identify the purpose of the porous cup. Most of these students recognized that the presence of the copper half cells in the second cell did not affect the overall voltage, but they did not explain why. Their most common mistake was to describe the copper as being inert or as not being part of the reaction. Students who attained the standard of excellence needed to score a 3 or higher. They successfully explained why the two copper half cells did not increase the voltage of the cell, either by showing that the net ionic reaction for both cells was the same or by proving that the voltage of the second cell was the same as the first, even though the copper half cell voltages were included. Students not attaining full marks did not communicate clearly the significance of their net reactions or their calculations for the overall question. On this 4-mark question, the average mark was 1.62 or 41% of the available mark.

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